SJSU SAN JOSÉ STATE UNIVERSITY

SJSU Undergraduate Research Grants

Development of a microfluidic approach for rapid and continuous detection of pathogens in food and water samples

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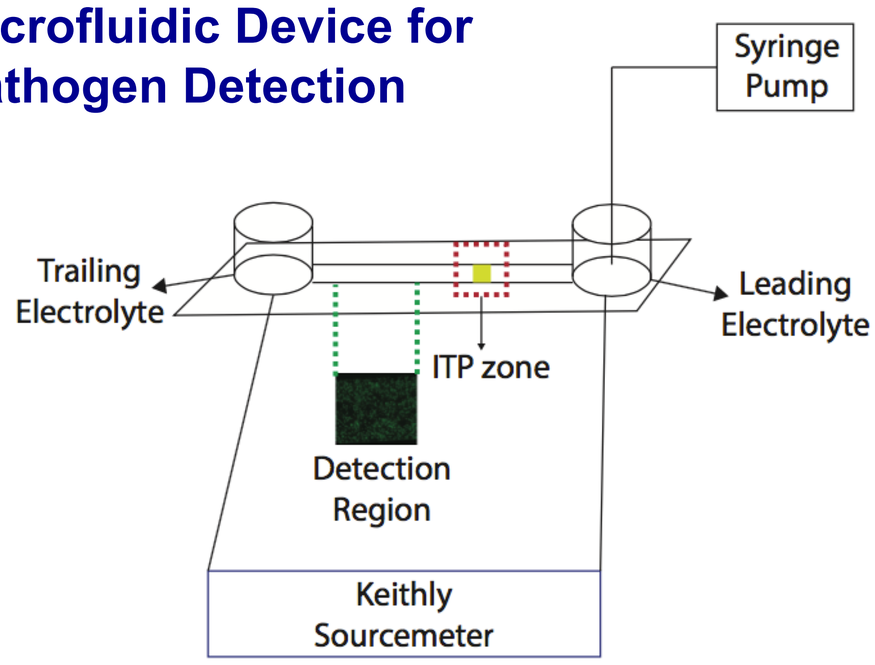
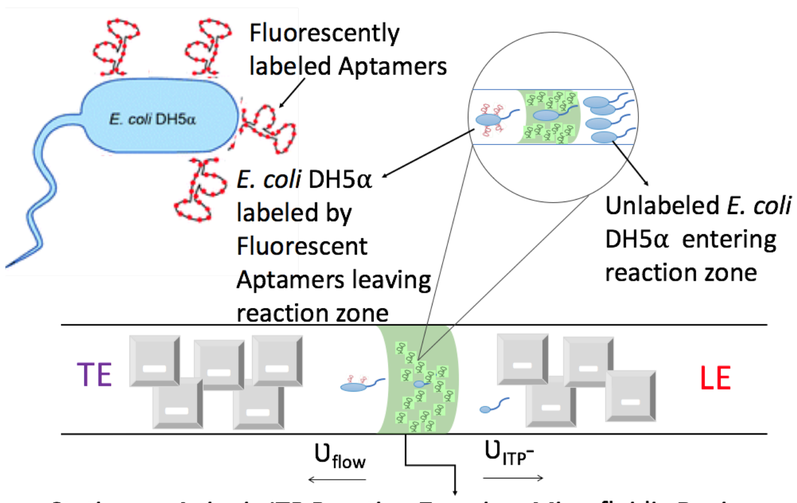
Abstract

A microfluidic device was developed for rapid and high sensitivity detection of pathogens from larger sample volumes by leveraging strong preconcentration of isotachophoresis (ITP). We have accomplished the first phase of the project where our microfluidic chip can control the location of a high-concentration stationary ITP probe zone for up to 1 hour by use of a syringe pump. The use of pressure driven flow and larger microfluidic device has enabled the control of the fluidic interface at a flow rate of 0.25 µL/min which results in processed volume of 15 µL per hour. This processed volume is 22 fold increase compared to the previously reported volume 0.648 µL per hour. Additionally, in the previous work a pre-purchased microfluidic device was used, whereas our process has included designing and testing various channels. The project is now in its second phase, where ITP buffers are being optimized to focus a fluorescently labeled DNA Aptamer that will bind to whole *E. coli* bacteria strain DH5α. Future work will focus on integrating the individual components of flow control, image processing, and ITP-based reaction together with bacteria containing sample solution.

Microfluidic Device for Pathogen Detection





Stationary Anionic ITP Reaction Zone in a Microfluidic Device

Design

- A fluidic interface for a flow control in PDMS channels by a syringe pump
- Parallelization for a scale-up

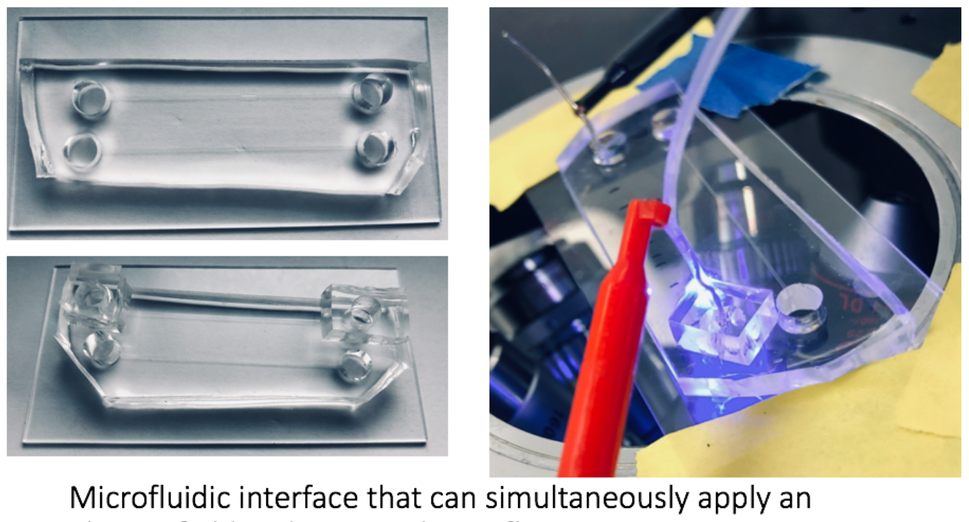
ITP

- Preconcentration of probes
- Stationary ITP by pressure driven flow [2]

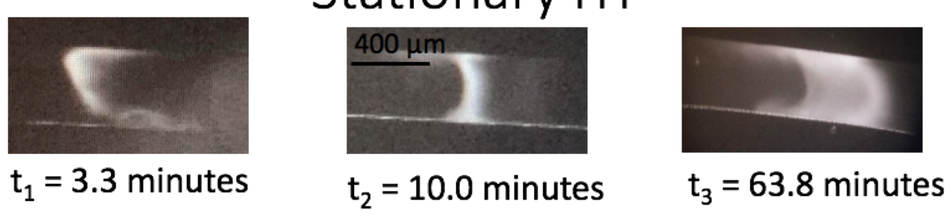
Probe

- DNA Aptamer that bind to whole *E. coli* bacteria [1]

Project Findings



Microfluidic interface that can simultaneously apply an electric field and syringe-driven flow



Research Questions

- What is the minimum concentration of bacteria needed for detection from a 1 mL sample?
- For real time monitoring, are we able to detect specific strains of bacteria?
- What is the maximum volume of sample that can be processed in 1 hour?

Citations

[1] Dua, P., Ren, S., Lee, S., Kim, J., Shin, H., Jeong, O., Kim, S., Lee, D. (2016). ”Cell-SELEX based identification of an RNA aptamer for *Escherichia coli* and its use in various detection formats”. *Molecules and Cells*, vol. 39(11), 807-813.

[2] Schwartz, O., Bercovici, M. (2014). “Microfluidic assay for continuous bacteria detection using antimicrobial peptides and isotachophoresis”. *ACS Publications Analytical Chemistry,* vol. 86, 10106-10113.